Infiltrated SrTiO3:FeCr-based anodes for metalsupported SOFC

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Publication date:
2012

DTU Energy Conversion
Department of Energy Conversion and Storage

Infiltrated $SrTiO_3$:FeCr-based anodes for metal-supported SOFC

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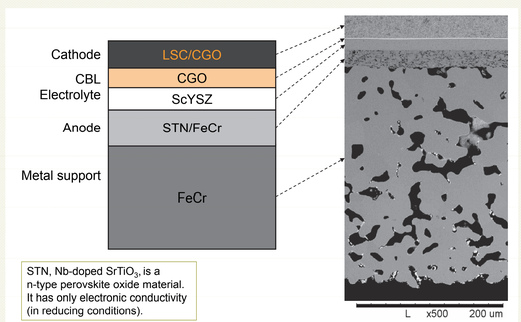
The concept of using highly electronically conducting backbones with subsequent infiltration of electrocatalytic active materials, has recently been used to develop an alternative SOFC design based on a ferritic stainless steel support. Testing and characterization of a metal-supported SOFC (MS-SOFC) where the anode backbone consists of a composite of Nb-doped $SrTiO_3$ (STN) and FeCr are presented. The results indicate that the STN component in the anode seems to have a positive effect on the corrosion stability of the FeCr-particles in the anode layer. Since STN is only electronically conducting, it is suggested that this phase limits the access of oxygen (ions) to the stainless steel surface in the anode backbone, and thereby improves the corrosion stability. Additional work is required to optimize the microstructure and to investigate the long term stability.

Cell design and fabrication

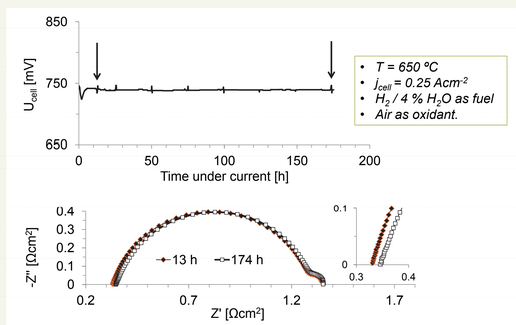
The cell design is based on a multilayered structure obtainable by conventional ceramic processing techniques. A porous metal support (ferritic stainless steel alloy) and a cermet layer, containing electronically conducting ceramic particles ($Sr_{0.99}Ti_{0.9}Nb_{0.1}O_3$, STN99) and FeCr particles, are co-sintered together with an electrolyte. After co-sintering, the electrocatalytically active phase ($Ce_{0.8}Gd_{0.2}O_{1.9}$ + Ni) is infiltrated into the porous structure. A $Ce_{0.9}Gd_{0.1}O_{1.95}$ (CGO10) cathode barrier layer (CBL) is deposited with PVD. As cathode a $(La_{0.6}Sr_{0.4})_{0.99}CoO_{3-\delta}$: $Ce_{0.9}Gd_{0.1}O_{2-\delta}$ composite was applied by screen printing.



Schematic illustration and SEM cross-section of the MS-SOFC cell with STN:FeCr as the anode backbone layer.

Electrochemical characterization

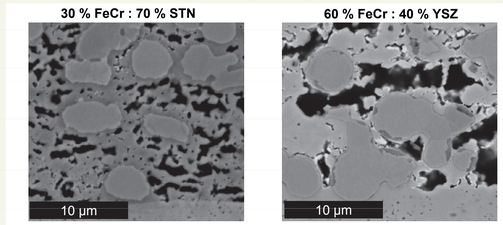
Initial polarization characteristics at various temperatures .



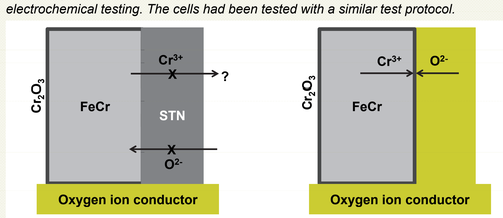
Galvanostatic durability curve (top) where the arrows indicate when EIS was conducted (bottom) under current load.

Microstructural characterization

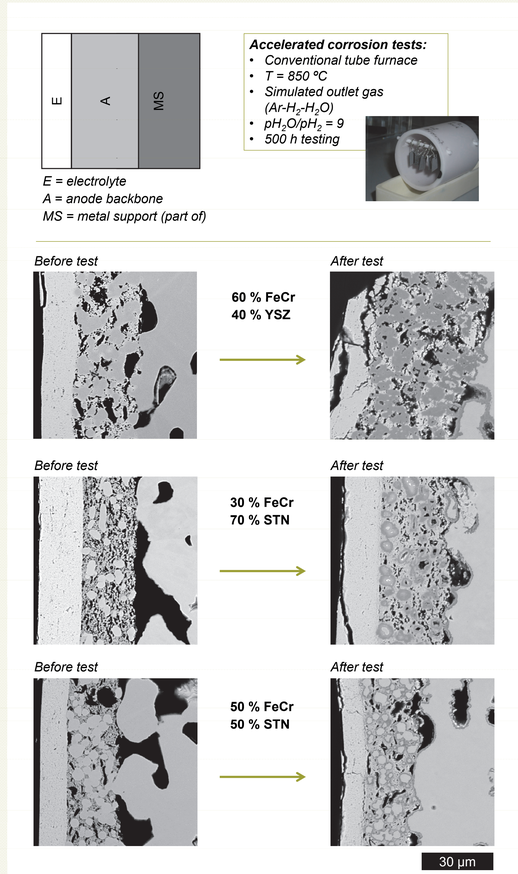
An electrochemically tested cell with FeCr:YSZ-based backbone (our normal configuration) has been included for comparison to show the microstructural effect of the STN phase on the corrosion of the FeCr particles. A clear Cr_2O_3 scale is formed on the FeCr particles in the FeCr:YSZ anode (dark grey phase), whereas a different behaviour is observed in the FeCr:STN case.



SEM images of two different types of anode backbones in the MS-SOFC after electrochemical testing. The cells had been tested with a similar test protocol.



Tentative hypothesis for the improved corrosion stability of the STN:FeCr-based anode backbones compared with FeCr:YSZ-based anode backbones.



SEM micrographs of half cells with various anode backbones before and after accelerated corrosion tests.

The development of metal supported SOFC is financially supported by Topsoe Fuel Cell A/S, the EU projects METSOFC (FP7-211940) and METSAPP (FP7-278257), The Danish National Advanced Technology Foundation and Energinet.dk under the ForskEL-programme